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Bacterial Chemotherapy in Veterinary Medicine*

by

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INTRODUCTION

By introducing the term chemotherapy Ehrlich intended to mark off from the general body of pharmacology a particular type of investigation having as its aim the discovery of chemical substances acting specifically on pathogenic infections. His motive was to shift the interest of pharmacologists from the host to the attacking parasite. The aim of chemotherapy was to find substances maximally toxic for the parasite and minimally toxic for the host. The development of this work was described by Dale (1923) who emphasized that despite Ehrlich's concepts no really fundamental advance had been made in our knowledge of chemotherapy.

With the advent of the sulphonamides Ehrlich's general concepts were largely confirmed and an immense impetus was given to chemotherapeutic research, but a very large number of compounds usually have to be tested before a satisfactory drug is produced. Even when one has found a highly active drug, there are many pitfalls which are illustrated by the work on 4:4'-diamino-diphenyl sulphone† H_2N–C_6H_4–SO_2–C_6H_4–NH_2. It was originally shown (Buttle *et al.*, 1937) that it was highly active against streptococcal infections in mice, but it was soon found that, due to methaemoglobin production and cyanosis, it was too toxic for use in man. McEwen *et al.* (1941) found that it was well tolerated in cattle, and starting from these observations we began to study its properties.

We found that it was more active than any of the sulphonamides against *Str. agalactiae* and produced the most persistent blood-levels in calves. Then came disappointments. Moderately large doses in sheep were liable to produce toxic nervous symptoms and the drug produced methaemoglobinaemia in pigs and horses. It seemed, however, that it would be valuable in the treatment of calf diseases until we found that, instead of being more active than the heterocyclic sulphonamides against some Gram-negative organisms, it was less active, being only about three times as active as sulphanilamide. Again, it appeared that it would be much superior to sulphanilamide for the treatment of mastitis by oral dosing, but then we found that, in contrast to sulphanilamide, it produced lower milk than blood-levels. Because of its lower toxicity and much greater activity it appears, however, that it may have a place in the treatment of mastitis by oral dosing.

Sulphone persists very well in the milk following injection into the udder, and is probably more persistent than any of the other sulphonamides (Francis, 1947). It appears, therefore, that it will be the sulphonamide of choice for this purpose. Good results have been obtained in preliminary experiments, but final conclusions must await more extensive trials.

THE PHARMACOLOGY OF THE SULPHONAMIDES

INFORMATION OBTAINED BY GIVING SINGLE, ORAL AND INTRAVENOUS OR INTRAPERITONEAL DOSES

We have studied the behaviour of the common sulphonamides in the calf, sheep, pig and horse, following a single oral, and intravenous or intraperitoneal dose of each drug. This has enabled us to reach conclusions concerning the absorption and excretion of the sulphonamides in the various species.

The simplest method of expressing the results is to measure the blood-level curve area (B.L.C.A.) which is a function of the concentration of drug in the blood and the time that it persists (Fig. 1).

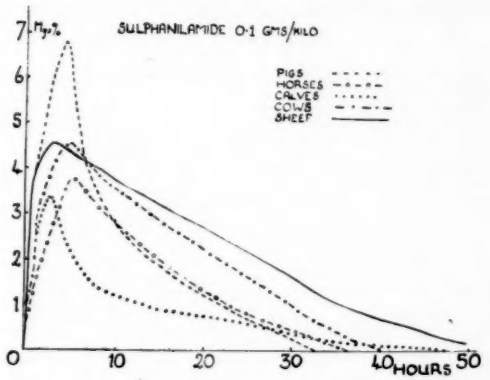


FIG. 1.—Blood-levels produced by sulphanilamide in animals following oral dosing.

In general the calf and sheep absorb and excrete the drugs more slowly than the pig, and the horse occupies an intermediate position. If, however, the B.L.C.A.s given by all the seven drugs in each species are averaged the B.L.C.A.s in the calf, sheep, pig and horse are almost identical. On the other hand, there are important differences in the behaviour of individual drugs in the various species (Table I); the behaviour of sulphanilamide in various species is shown in Fig. 1.

TABLE I

RELATIVE BLOOD-LEVEL CURVE AREAS IN ANIMALS PRODUCED BY VARIOUS SULPHONAMIDES. IN EACH SPECIES SULPHANILAMIDE HAS BEEN GIVEN AN ARBITRARY VALUE OF ONE

	Calf	Sheep	Pig	Horse	Average
Sulphanilamide ...	1·0 (1)	1·0 (2·9)	1·0 (1·9)	1 (1·5)	1·0
Sulphathiazole ...	0·41	**0·014**	0·28	0·38	0·27
Sulphapyridine ...	1·06	**0 098**	0·57	1·0	0·68
Sulphadiazine ...	0·37	0·27	0·39	1·3	0·58
Sulphamerazine ...	3·9	1·1	1·32	1·6	1·98
Sulphamezathine ...	2·5	0·64	**2·32**	1·8	1·81
Sulphone	6·5	1·5	1·54	2·2	2·93

Figures in brackets show the B.L.C.A. of sulphanilamide in each species when the area in the calf is given a value of 1.

The average B.L.C.A.s produced by each of the drugs in the four species are shown in Table I. It will be seen that if sulphanilamide is given a value of unity, sulphamezathine and sulphamerazine produce B.L.C.A.s of about 2 and sulphone of 3. Sulphadiazine and sulphapyridine produce B.L.C.A.s of about 0·6 and sulphathiazole of only 0·3. From a consideration of these results and those obtained following intravenous inoculation in the calf and sheep and intraperitoneal in the pig, we can reach the conclusions shown in Table II (overleaf) concerning absorption of the various drugs and their disappearance from the blood.

These results give a correct general impression concerning the behaviour of the different drugs in the four species studied, but there are a number of species differences which should be noted (Table I). In the sheep (and probably the cow, see later), sulphanilamide produced relatively better levels than in the other animals and sulphathiazole was particularly poor. In the calf sulphone was outstandingly persistent, but sulphanilamide produced poor levels. In the pig sulphamezathine was outstanding and although it also

* This paper formed the basis of a talk given to the Eastern Counties Veterinary Society in May, 1946.

† Henceforth called sulphone.

produced the best levels in the horse, sulphadiazine gave higher levels than in the other species.

TABLE II

THE AVERAGE BEHAVIOUR OF VARIOUS SULPHONAMIDES IN THE CALF, SHEEP, PIG AND HORSE

	Absorption	Disappearance from blood
Sulphanilamide ...	+++	+
Sulphathiazole ...	⊥	⊥
Sulphapyridine ...	++	+
Sulphadiazine ...	+	++
Sulphamerazine ...	+++	+++
Sulphamezathine ...	+++	+++
Sulphone	+++	+++
⊥ ...	Very poor	Very rapid
+	Poor	Rapid
++ ...	Good	Moderate
+++ ...	Very good	Slow

i.e., +++ in both columns indicates that good blood-levels are produced.

We were particularly interested in the behaviour of sulphone in the calf and the effect of giving single doses of 0·2 and 0·4 gm./kg. as well as 0·1 gm./kg. were studied. It can be seen from Fig 2 that a dose of 0·1 gm./kg. produced a maximum blood-level of 3·8 mg. per cent. but increasing it to 0·2 and 0·4 gm./kg. only produced maximum blood-levels of 5·6 and 6·4 mg. per cent.

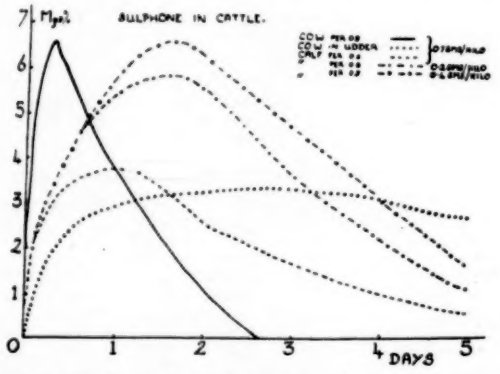


FIG. 2.—Blood-levels produced by various doses of sulphone in the cow and calf when given *per os* and into the udder.

This behaviour is not surprising when one considers the very low solubility of sulphone and indeed is advantageous, for it will be seen that a single oral dose of 0·2 gm./kg. produced blood-levels above 1 mg. per cent. for five days.[1] None of the calves to which we gave 0·4 gm./kg. showed toxic symptoms, but this dose is probably approaching the limit of safety. A related compound, 4:4′-nitroamino-diphenyl sulphone ("364 B") behaved in a similar way, except that it was even more slowly absorbed.

Four sheep were given doses of 0·2 gm./kg. of sulphone. Average maximum blood-levels of about 7 mg. per cent. were produced after 24 to 32 hours (Table III).

Two of the sheep died, however, and one of the others showed severe toxic symptoms, but eventually recovered. The toxic action of sulphone in the sheep appears to be exerted on the nervous system. Without describing the effects in detail it may be said that the first symptoms are excitement, and ataxia which begins in the hind limbs; there may be a nervous nodding of the head. The animal soon falls to the ground and lies on its side. The nose may be pointed in a direction at right angles to the spinal cord, in the dorsal plane. Both pairs of limbs may be extended in a forward position or there may be galloping movements. Breathing is rapid, the temperature elevated, and there is often a nervous twitching of the lips or grinding of the teeth. Sheep 5 continued in this state for 48 hours but eventually recovered. It is interesting to note that recovery occurred when the blood-level was considerably higher than when the symptoms began. Other evidence suggests that the central nervous system may acquire a certain tolerance to the toxic effects of sulphone.

We have made a less complete study in the cow but because of the high activity of sulphone against *Str. agalactiae* we have compared it with sulphanilamide and the results are shown in Fig. 3.

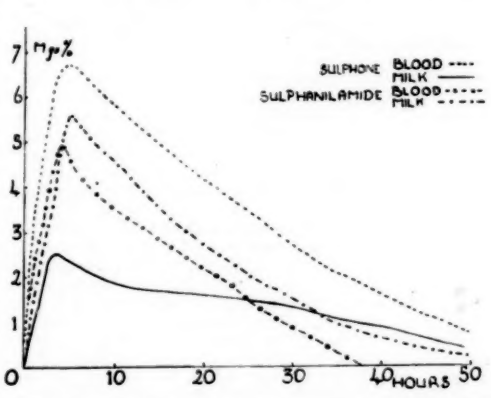


FIG. 3.—Blood- and milk-levels in the cow produced by sulphanilamide and sulphone following oral dosing, three cows used for each drug.

It can be seen from Table IV, in which the figures for the calf are included, that the B.L.C.A. produced by sulphanilamide was twice as great in the cow as in the calf.

[1] STEWARD, J. S. (1947. *Vet. Rec.* **59**, 21-27) has shown that this drug need only be given once every 48 hours to produce good therapeutic results.

TABLE III

BLOOD-LEVELS PRODUCED BY THE ADMINISTRATION OF 0·2 GRAMME PER KG. OF SULPHONE *Per Os* TO SHEEP

Exp. No.	Sheep No.	Time in hours											Time in days	
		1	2	3	4	5	6	7	24	32	48	56	3	4
8	35	—	—	—	—	—	—	—	7·0	4·6	6·0	3·6	0·7	0
15	17	1·8	2·6	3·6	4·2	4·8	5·2	4·6	6·6	10·4	Dead			
16	22	1·5	2·2	2·6	3·0	3·6	3·0	3·2	5·2	6·2	5·2	6·5	Dead	
43	5	1·8	2·6	2·7	2·9	3·6	3·8	4·0	4·2	6·6	5·2	4·4	4·4	2·0
	Average	1·7	2·47	2·97	3·37	4·0	4·0	3·93	5·75	6·95	5·47	4·83	2·55	1·0

TABLE IV

BLOOD AND MILK-LEVEL CURVE AREAS FOLLOWING A SINGLE ORAL OR INTRAMAMMARY DOSE OF 60 GRAMMES OF SULPHONE TO COWS AND 0·1 GRAMME PER KG. TO CALVES*

		Sulphanilamide	Sulphone
Blood	Cow : orally	1	2·12
	udder	—	5·0
	Calf : orally	0·44	2·85
Milk	Cow	1·22	0·84

* A dose of 60 grammes in the cow is probably slightly more than 0·1 gramme per kg.

Sulphone produced a slightly greater B.L.C.A. in the calf than the cow, and the shape of the curve was entirely different (Fig. 2). As far as we are aware, this is the first time these differences in behaviour between the calf and the cow have been reported, and we now have evidence that they are due to the excessive acetylation of sulphanilamide in the calf. Drugs which give good levels in the calf are not excessively acetylated. The blood-levels produced following injection of sulphone into the udder (Francis, 1947) confirm this belief and indicate that there is no important difference in the rate of excretion from the kidney of the cow and calf. It was disappointing to find that the milk-levels produced by sulphone were only about one-third the blood-levels in normal cows, whereas the milk-levels produced by sulphanilamide were a little higher than the blood-levels (Fig. 3).

Discussion and Application of Results

General Considerations

The effectiveness of any chemotherapeutic drug depends on the blood-levels it produces and its intrinsic antibacterial potency. The average blood-levels produced by the common sulphonamides are shown in Figs. 4 and 5, which give a fair general picture, although it has been shown that there are quite important differences between the various species and that there are big differences in the relative potencies of the sulphonamides against different bacteria.

In addition, the relative importance of the broad bacterial types as disease-producing agents varies considerably from one species to another; it follows that every species presents a separate problem to the person interested in chemotherapy. The subject can perhaps be dealt with most clearly by assessing the relative potencies of the sulphonamides against different bacteria, their toxicity for animals, and then discussing the treatment of specific diseases.

Despite the great amount of work done on the chemotherapeutic activity of the sulphonamides, some of which is summarized in Table V, it is even now very difficult to state precisely their relative antibacterial potencies.

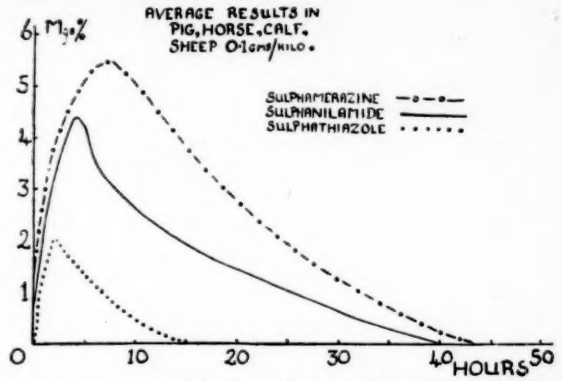


FIG. 4.—Average blood-levels produced by each sulphonamide in four species of animals following oral dosing. Species differences are shown in Table III.

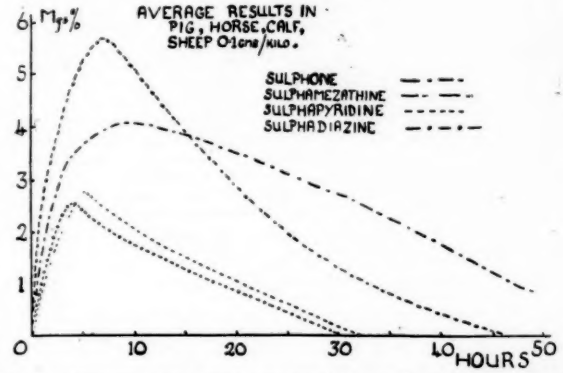


FIG. 5.—Average blood-levels produced by each sulphonamide in four species of animals following oral dosing. Species differences are shown in Table III. It will be seen that the highest peak-level is given by sulphamezathine followed by sulphone, sulphapyridine and sulphadiazine.

TABLE V

THE RELATIVE POTENCIES OF THE COMMON SULPHONAMIDES AGAINST VARIOUS BACTERIA

	In vivo in mice*								*In vitro*		
	1	1	1	7	2	3	1	4	Schmidt *et al.*, 1944							5	6
	In eggs	In mice	*In vitro* in milk	*In vitro* in milk	*Haem. strepts.*	*Pneumococci*	*Past. septica*	*H. influenzae*	*Pneumococci*	*Haem. strepts.*	Friedländer	*Staphs*	*Shigella*	Average 5 species	Same 5 species	Ten intestinal pathogenes	*Streptococci* *Pneumococci* *B. coli*
	Str. agalactiae																
Sulphanilamide	1·0	1·0	1·0	1·0	1·0	1·0	1·0†	—	—	—	—	—	—	—	—	—	—
Sulphapyridine	1·25	1·25			1·09	2·3	5·2	1·0	—	—	—	—	—	—	—	—	—
Sulphamezathine	1·84	1·22	—	—	—	—	6·9	—	1·0	1·0	1·0	1·0	1·0	1·0	1·0	1·0	1·0
Sulphamerazine	—	—	—	—	—	—	7·2	—	0·9	0·83	2·5	0·29	0·38	0·76	0·9	0·33	1·0
Sulphadiazine ...	1·30	2·0	—	2·1	—	—	9·2	3·6	0·66	1·16	3·8	1·2	2·3	1·29	0·9	0·33	1·3
Sulphathiazole	2·33	1·8	—	2·4	—	2·8	13·3	6·0	—	—	—	—	—	—	3·4	—	—
Sulphone ...	3·15	3·0	4·8	—	2·92	13·6	3·0	—	—	—	—	—	—	—	—	—	—

1. Francis, Peters & Davies (1947b). 3. Litchfield *et al.* (1940). 5. Schweinburg & Yetwin (1945). 7. Brownlee (1945).
2. Marshall *et al.* (1940). 4. Pittman (1942). 6. Bliss & Deitz (1944).

* All comparisons in mice are at equal blood-levels, or, in the work of Francis, Peters & Davies (1947 b) and Pittman (1942), adjustment has been made for differences in blood-levels by using the figures of Rose & Spinks (1946).

† The activity of sulphanilamide is so low that the relationship between it and the other sulphonamides may not be accurate.

Our own results and those of others show that their potency may be very different against different organisms and may vary against the same organisms in different media. In Table V an attempt has been made to relate our own findings to those of some other workers.

The action of sulphanilamide was first demonstrated against Group A streptococci and it will be seen that against this organism the heterocyclic sulphonamides (all the newer derivatives except sulphone) are only one to two times more potent and sulphone three times more potent than sulphanilamide. Against pneumococci the difference is greater and it will be realized that sulphapyridine, the first of the heterocyclic sulphonamides, was introduced largely for the treatment of pneumonia in man. The position is entirely different with the Gram-negative organisms. The activity of sulphanilamide is so low that it is practically useless, but the heterocyclic sulphonamides are quite active. Sulphone, instead of being even more active, however, is only about thrice as potent as sulphanilamide. Of the heterocyclic sulphonamides sulphapyridine generally appears to be the least active. We found sulphamerazine and sulphadiazine more potent than sulphamezathine against *Pasteurella septica* infection, but Schmidt *et al.* (1944) tested these three compounds against five different infections in mice and found, on the average, that sulphamezathine was slightly more potent than sulphamerazine and less potent than sulphadiazine. There was very little difference in their relative potencies *in vitro*. Schmidt *et al.* (1944) found sulphadiazine slightly the more potent *in vitro*, but Schweinberg & Yetwin (1945) found that sulphamezathine was on the average about three times more active than the other two drugs against ten species of intestinal pathogens, although this finding should be treated with reserve.

Sulphathiazole may be slightly more active against streptococci than the three drugs just considered, but there can be no doubt that it is definitely more potent against the majority of Gram-negative organisms. Unfortunately, there is little precise information based on the result of animal experiments. As a generalization and with full knowledge that there may be exceptions, it is perhaps permissible to say that sulphamezathine and sulphamerazine are one-and-a-half times more potent than sulphapyridine and sulphadiazine is slightly more potent. Sulphathiazole is probably one-and-a-half to two times more potent than sulphamerazine.

Toxicity of the Sulphonamides for Animals

The toxicity of sulphone has already been described. The only animal in which it is entirely satisfactory for systemic use is the bovine. Three calves in poor condition, recently arrived from market, died after large doses of sulphone, but from the published evidence (Francis, 1946b) it seems that it is no more toxic than sulphapyridine or sulphathiazole for the calf. McEwen *et al.* (1941) found that doses of approximately 0·3 gm./kg. of sulphone produced maximum blood-levels of 12 to 16 mg. per cent. in heifers. In only one animal were toxic effects observed, and McEwen concluded that the drug was better tolerated than sulphanilamide which often produces diarrhoea in cattle. These results conform with our own findings and it appears that sulphone is very well tolerated by the cow. On the other hand, published evidence (Francis, 1946b) indicates that sulphathiazole and sulphapyridine may quite readily produce toxic effects in cows.

There is little information concerning the other sulphonamides, but Thorp (1945) found that sulphadiazine fairly easily produced toxic effects in calves. Our own observations, together with those in man and laboratory animals, indicate that sulphamezathine is the least toxic of the sulphonamides.

Treatment of Animal Diseases with Sulphonamides

Because large numbers of animals are not hospitalized reliable comparisons between the value of different drugs in many conditions are almost entirely lacking and are unlikely to be obtained in the near future. From a consideration of the pharmacology of the sulphonamides and their antibacterial potency some tentative conclusions have therefore been drawn concerning their probable relative value in different animal diseases. It is fully realized that these tentative conclusions require confirmation in the naturally occurring diseases and the subsequent account should be read with this proviso in mind.

Pneumonia and Septicaemia in Cattle, Sheep and Pigs

The heterocyclic sulphonamides are highly active against *Past. septica*, which is commonly associated with pneumonia (Table V), and in the calf it is probable that sulphamezathine and sulphamerazine would be the most effective drugs and that there would be little difference in their potency. Sulphathiazole and sulphadiazine would probably be less potent at equal doses, but with frequent large doses sulphathiazole might be the most effective drug, if it were not toxic. Sulphapyridine and sulphone would be less potent than the other drugs and sulphanilamide almost without action. These conclusions are generally confirmed by the findings of Thorp (1945) and it is interesting that sulphathiazole in large doses is probably the most effective of the sulphonamides against bubonic plague (Sokhey & Wagle, 1940), although *Past. pestis* appears to be more resistant to the sulphonamides than *Past. septica*. Streptococcal and pneumococcal septicaemia and pneumonia occur occasionally in the calf, and when they do sulphone would undoubtedly be the drug of choice. In the sheep, sulphamerazine, followed by sulphamezathine, would probably be the drugs of choice against pasteurella infections, which are commonly associated with pneumonia in these animals; sulphathiazole and sulphapyridine produce very poor blood-levels in the sheep. For the joint-ill in lambs, which is caused by streptococci, sulphanilamide will remain the drug of choice.

In the pig sulphamezathine would probably be outstanding, followed by sulphamerazine, and the same would be true of infections due to *Haemophilis influenzae*.

Enteric Infections in Calves and Pigs

It has been commonly assumed that sulphaguanidine, or one of the newer drugs which maintain a high concentration in the bowel, would be indicated for the treatment of enteric infections. Whenever these become serious, however, there is invasion of the intestinal mucosa, and frequently in calves and pigs a septicaemia. Work on coccidiosis (Steward, 1946) shows quite clearly that for the treatment of an infection in the intestinal mucosa it is the blood-level which is important, and there is increasing evidence in human medicine that the potent, readily absorbed sulphonamides are much more active than sulphaguanidine, and probably more active than such drugs as succinyl sulphathiazole. For instance, in the treatment of bacillary dysentery, Eisenoff & Goldstein (1943) obtained complete or temporary elimination of intestinal pathogens from 80 per cent. of patients treated with sulphathiazole, 70 per cent. with sulphadiazine, 63 per cent. with succinyl sulphathiazole and only 37 per cent. with sulphaguanidine. Scadding (1945) also concluded that the well-absorbed sulphonamides were probably more effective than sulphaguanidine, and emphasized the importance of concentration in the bowel wall, *i.e.*, the blood-level. Some workers, such as Wise & Anderson (1944 & 1945; see also Francis, 1943 & 1946b) have reported good results in the treatment of calf scours with sulphaguanidine, but others have obtained negative results. It is generally recognized that sulphaguanidine has only low antibacterial potency and Brownlee (1945) found it practically inactive against strains of *B. coli* isolated from calves suffering from calf-scours. The U.S. Army authorities now recommend sulphadiazine for the treatment of enteric infection in man. As far as one can judge from the available evidence the relative values of sulphamezathine, sulphamerazine, sulphadiazine and sulphathiazole would be roughly the same as in *Past. septica* infection and they would all be better than sulphaguanidine. It should be realized, however, that many of the organisms causing enteric infections are much less susceptible to all the sulphonamide drugs than is *Past. septica*.

Diseases of Horses and Foals

The horse is the only species dealt with in which haemolytic streptococci are the common pus-producing organisms and "secondary invaders." Information concerning the important group of respiratory diseases in the horse has been reviewed by Francis (1942). In some, if not all, a virus is the primary aetiological agent, but Group C haemolytic streptococci play a very important role, and against this organism there is not a great difference in the relative potencies of sulphanilamide on the one hand, and the heterocyclic sulphonamides on the other. For this reason and because they do not produce much better blood-levels in the horse than sulphanilamide, the latter drug will probably continue to play an important part in the treatment of equine respiratory diseases.

Horses take sulphamerazine, sulphamezathine and sulphadiazine in their food more readily than sulphapyridine or sulphathiazole and there is probably little to choose between the three former drugs given orally, but sodium sulphamezathine would be the most suitable for injection. Sulphanilamide is of little value for the treatment of the enteric and septicaemic conditions of foals which are usually caused by various species of Gram-negative organisms. The heterocyclic sulphonamides are, however, active against most of these infections and their pharmacology in the foal and horse is probably similar. Sulphone cannot be given for the treatment of pneumonia because of methaemoglobin production, but it may be valuable for local application to wounds.

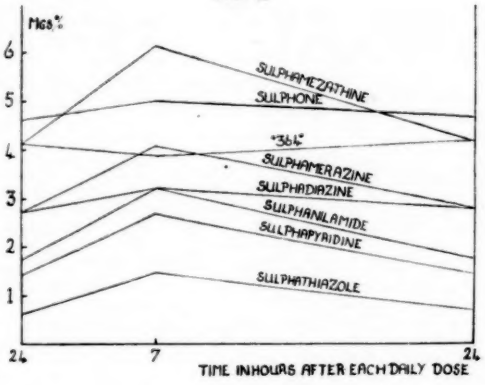
Diseases of Poultry

We have done no work with poultry. The results of Marshall (1945), however, indicate that the relationship between the blood-levels produced by the various sulphonamides in chicks is very similar to the average relationship in the four species we have studied (Figs. 4 and 5), except that the levels of free sulphanilamide are very low, and this drug is known to be valueless in poultry. Poultry suffer chiefly from salmonella and pasteurella infections; sulphathiazole appears to have been used most extensively against bacterial infections without any real trial of the other drugs, and variable results have been obtained (Hinshaw & McNeil, 1946; Bankowski, 1943; Wernicoff & Goldhaft, 1944). Sulphamezathine, sulphamerazine and sulphadiazine would all probably be more effective drugs. These conclusions are supported by the results of Severens *et al.* (1945) who found that sulphamerazine and sulphadiazine were the most effective of seven sulphonamides tested against *S. pullorum* infection in chicks. Birds treated when one day old contained no pullorum agglutinins in their blood when nine months old.

Dosage of the Sulphonamides

From the results described in this paper, together with those obtained by Francis (1947), when repeated doses of the sulphonamides were given to animals, the following doses appear suitable. In calves and pigs an initial dose of 0·1 gm./kg.* followed by 0·05 to 0·1 gm./kg. of sulphamezathine or sulphamerazine once daily would be adequate (Fig. 6) although larger doses of sulphamezathine may be given with safety when this is desirable. In the horse and the sheep the daily dose should not be lower than 0·1 gm./kg., except with sulphone. Calves and pigs need not be dosed more than once daily, with the foregoing drugs, but dosing twice daily is probably desirable in other animals. Slightly larger doses of sulphadiazine, and larger daily doses, given at intervals of eight or twelve hours, of sulphapyridine, sulphanilamide and sulphathiazole, are probably necessary.

Fig. 6.



Average blood-levels in calves given an initial dose of 0·1 gm./kilo followed by four more doses of 0·05 gm./kilo once daily.

Blood samples were taken in the afternoon, seven hours after dosing, and in the morning immediately before dosing, *i.e.*, 24 hours after the previous dose.

Penicillin

This drug will obviously continue to play a major part in the chemotherapy of human infections. The position in animals is entirely different: many of the important animal diseases are caused by organisms relatively resistant to penicillin and in addition penicillin is a drug difficult to administer in practice unless new methods are developed.

Apart from streptococcal mastitis, which will be considered separately, there are two organisms against which penicillin may be useful. They are *C. pyogenes* and *Erysipelothrix rhusiopathiae*. Despite a belief that the sulphonamides exert a beneficial effect on "summer mastitis" and other *C. pyogenes* infections (Roach, 1945; Lovell, 1945) we have found that they have no action against *C. pyogenes* infection in the chick-embryo and only a very slight action against this infection in the mouse: a result similar to that obtained by Kolmar (1941) against *C. diphtheriae* infection, and confirmed by the clinical observations of Arthur (1943), Curtis (1945), Berger (1945). We and other workers (see Woodbine, 1946) have found that the sulphonamides have no action against *E. rhusiopathiae*. We have found that penicillin inhibits the multiplication of *C. pyogenes* in the chick-embryo and protects mice from an acute infection. On the other hand, it has had little or no effect on a few established cases of summer mastitis which we have treated by the infusion of 50,000 units per quarter and Arthur (1947) has found that much larger doses are ineffective. Again, similar results have been obtained in the treatment of *C. diphtheriae* infection of guinea-pigs: penicillin is effective against an acute septicaemic infection but not a chronic local lesion (Ercoli *et al.*, 1945; Young & Mood, 1946).

Conflicting results have been reported concerning the value of penicillin against *E. rhusiopathiae* infection in mice. Harvey *et al.* (1945) found it highly effective but Woodbine (1946, who gives other references) found it of little value. In any event immune serum is very effective against this infection in pigs.

Penicillin is of value in the streptococcal infections of horses, but Doll & Dimmock (1946) found that about 300,000 units of penicillin would have to be given to an averaged sized horse every three hours to maintain adequate blood-levels—a procedure which could obviously only be carried out on valuable animals.

Mastitis

The treatment of mastitis undoubtedly presents the most important problem in the bacterial chemotherapy of animal diseases, and since the early experiments on the Continent which led to the development of the acridine compounds for the treatment of mastitis were completed (see Francis, 1943) a great deal of field work has been carried out. There have, however, been surprisingly few laboratory studies of the action of chemotherapeutic compounds against *Str. agalactiae*. This is no doubt largely because reproducible infections had not been established in laboratory animals. We have now produced such an infection in chick-embryos and mice (Francis & Peters, 1947).

Treatment With Sulphonamides and Antiseptics

Sulphanilamide given orally has become the standard treatment for acute streptococcal mastitis, but although it often produces a marked improvement in the clinical condition there is a consensus of opinion that it is of little value for eradication of infection (Report, 1946b; for other evidence see Francis, 1943; Roach & Hignett, 1945). Good results have been claimed following the use of silver oxide and tyrothricin but both substances tend to be irritant and may cause severe damage to the udder (Schalm, 1944b; Andberg & Weirether, 1943 and 1944). We found them to have little or no action against *Str. agalactiae* infection in the chick-embryo and according to Klussendorf (1945) they are being used less frequently in practice. Our work on the value of antiseptics in the chick-embryo supports the conclusion reached from a review of the literature (Francis, 1943) that acriflavine is the most effective of the acridines. There is a complete consensus of opinion that the most favourable time for treatment is when the cow is nearly or completely dry, and Schalm (1944b) has given special attention to this subject, but even then only about 50 to 60 per cent. of bacteriological cures may be expected with one treatment.

It appears that sulphanilamide in oil is one of the most effective treatments and certainly less liable to damage the udder than most others (Sweet *et al.*, 1944; Johnson, 1944; Edwards & Brownlee, 1946). The results obtained with most of the older remedies, however, have not been outstanding and Roach (1945) stated that the general feeling of research workers in this country is that a bacteriological cure of *Str. agalactiae* mastitis is something of a rarity.

From our work in the chick-embryo, the mouse and in milk (Francis, Peters & Davies, 1947b) we concluded that sulphone was three to four times more potent than sulphanilamide against *Str. agalactiae*, being the most potent of the sulphonamide group of drugs. In addition, it is about ten times more persistent in the cow's udder than is sulphanilamide and probably the most persistent of all sulphonamides. We found that a dose of ten grammes infused into a lactating quarter, or one affected with acute mastitis, may be left in for two to three days and during this period maintains high milk concentrations and relatively high blood concentration (Francis, 1947).

Suspensions of the sulphonamides are not always easy to inject into the udder, and with the exception of sulphacetamide their sodium salts are too irritant for this purpose. There are, however, a number of complex soluble derivatives of the sulphonamides

* A dose of 0·1 gm./kg. corresponds to a dose of 1 drachm per 60 lb. or 1 ounce per 6 cwt.

which can be used, but it should be clearly realized that their activity depends solely on the amount of sulphonamide which they contain and the sulphonamide in these complex solutions is not necessarily in an active form.

We compared the activity of a number of soluble derivatives in the chick-embryo and mouse (Francis, Peters & Davies, 1947c). The general conclusions were that sulphanilamide L.S.F. was largely inactive due to the stability of the complex and sulphacetamide was also of very low potency. On the other hand, sulphanilamide and sulphone E.O.S., solupyridine and soluseptasine had about the activity one would expect from their content of the respective parent compounds.

Doses of 10 to 20 grammes of sulphone infused into all quarters of dry cows produced effective milk concentrations for long periods and blood concentrations for 5 to 15 days. These results led us to believe that sulphone would be a considerably more effective drug than sulphanilamide for infusion into the cow's udder and some preliminary trials have been carried out. Dry cows which had shown clots in the milk or other evidence of mastitis during their previous lactation were injected by J. Berger, M.R.C.V.S. In addition we have carried out work on eradication in two herds badly infected with *Str. agalactiae*. The combined results with sulphone are shown below and whilst they are good the effect of a simultaneous single dose of 10 grammes of sulphone and 50,000 units of penicillin was tried.

Treatment	Number of Quarters					
	Dry		Lactating		Total	
	No. Treated	% Cured	No. Treated	% Cured	No. Treated	% Cured
Sulphone, 10-20 gms., single dose	35	82	16	69	51	78·4
Sulphone, 10 gms., penicillin 50,000 units, single dose	20	100	34	89	54	94·4
Total	55	89	50	84	105	86·6
Report, 1946a. Penicillin, 100,000 units, single dose					140	57·9

It will be seen that all of 20 non-lactating quarters were freed of infection and 89 per cent. of 34 lactating quarters. These are very good results for a single injection treatment and if they are confirmed it appears that the method will provide a really practical means of treating clinical streptococcal mastitis and controlling the infection. In the two herds we have studied the infection has been controlled for 14 and four months respectively.

Both for the treatment of acute mastitis and for the treatment of dry cows only one injection has been used. This is a very important feature and together with the fact that sulphone can be suspended in oil and dispensed in single-dose collapsible tubes renders it much the simplest method of treating mastitis.

Treatment with Penicillin

Penicillin, given systemically, does not pass into the milk (Seeley *et al.*, 1945; Barker *et al.*, 1946) but there are now quite a number of papers on its value when injected into the udder. As usual, widely differing results have been obtained by various investigators but they cannot be reviewed here. An American Committee (Report, 1946a) states that the infusion of 25,000 to 50,000 units of penicillin per quarter on four successive days produces a cure in most cases of *Str. agalactiae* infection. They state that a single dose of 100,000 units will produce a cure in about 75 per cent. of quarters but in trials organized by the A.R.C. (Report, 1946b) only 57·9 of 140 quarters treated in this way were cured; these results are no better than those claimed with many of the older treatments. Two treatments with 20,000 units at an interval of 24 hours gave 79·9 per cent. of cures, but more frequent treatments were not advantageous. Less satisfactory results have been obtained in the treatment of staphylococcal mastitis (Schofield, 1946). It would appear that penicillin will not be so effective that bacteriological control of treatment becomes unnecessary, and treatment is more difficult than with sulphone. The reason why penicillin does not produce a higher percentage of cures may be that it does not reach all parts of the udder, whereas sulphone is absorbed into the blood stream and again secreted in the milk.

Murnane (1945) showed that penicillin was much more persistent in dry than lactating quarters, and quite apart from this, penicillin (or any other non-irritant agent) does not have to be milked out when the cow is not in lactation. For these reasons and because there is a greater tendency to recovery when the cow is dry it appears that special attention might well be given to the treatment of dry cows.

Summary

1. The relative potencies of various drugs against *Str. agalactiae* and *Past. septica* infections are described. The behaviour of the sulphonamides when given by a variety of routes in the cow, calf, sheep, pig and horse has been studied.

2. The heterocyclic sulphonamides are only one to two times more potent than sulphanilamide against streptococci, but 4:4'-diamino-diphenyl sulphone is three to four times more active. Sulphanilamide is of very low potency against Gram-negative organisms and the heterocyclic sulphonamides are three to nine times more potent. As a generalization, it may be said that sulphamezathine and sulphamerazine are about one and a half times more potent than sulphapyridine, and sulphadiazine is slightly more potent. Sulphathiazole is probably one and a half to two times more potent than sulphamerazine.

3. It is emphasized that mastitis associated with *Str. agalactiae* is probably an infectious disease which can be eradicated from a herd, area or a country. In this it differs from other forms of mastitis.

4. Acriflavine probably remains the best of the "antiseptics" for injection into the cow's udder. Tyrothricin and silver proteinate were of very low activity against *Str. agalactiae* infection in the chick embryo. Suspensions of sulphonamides in oil are almost certainly superior to the available soluble derivatives of the sulphonamides for injection into the udder.

5. The value of sulphone for the treatment of mastitis by oral dosing is reduced because it produces lower milk than blood-levels, but it is probably the most persistent of the sulphonamides when injected into the udder. This, combined with its high antibacterial potency, strongly suggests that it will be the sulphonamide of choice for the treatment of mastitis. Doses of 10 to 20 grammes per quarter have been used and we have succeeded in controlling mastitis associated with *Str. agalactiae* in two badly infected herds. In addition, Mr. J. Berger, M.R.C.V.S., has had good results using the drug in practice. Although the drug is specially recommended for the treatment of dry cows, good results have been obtained in the treatment of acute and latent mastitis in lactating cows when the drug has been left in for two to three days without milking.

It is evident that at least two injections of penicillin have to be given to obtain the best results in the treatment of mastitis and, in addition, the watery solutions of penicillin which have been used are difficult to handle in the field. In contrast, we have used sulphone in collapsible tubes with a nozzle attached. This greatly facilitates treatment and there is no danger of spreading infection, because a separate tube can be used for each quarter.

6. Sulphone produces the most persistent blood-levels in the domestic animals, except in the pig where its place is taken by sulphamezathine. Sulphone is less toxic than sulphanilamide for the bovine, but in other species it produces various toxic effects. Apart from sulphone, sulphamerazine and sulphamezathine produce the best blood-levels, being markedly superior to sulphadiazine and sulphapyridine, which in turn are much better than sulphathiazole. There are, however, variations in the different species which have been shown in tables. From a consideration of these facts, together with the relative potencies of the sulphonamides, and evidence from the literature, the following conclusions are drawn concerning the probable value of the various drugs for the treatment of diseases in the different animal species: final conclusion must, of course, await extended trials.

7. For the treatment of pneumonia in cattle, sheep and pigs, sulphamezathine and sulphamerazine will probably be the most effective drugs, although sulphathiazole might be the most active if given frequently and in large doses. In streptococcal or pneumococcal septicaemia and pneumonia in the calf sulphone would be outstanding.

8. There can be no doubt that sulphaguanidine is contra-indicated for treating the enteric diseases of animals, because other drugs are more effective. There may be little to choose between the value of sulphamezathine, sulphamerazine, sulphadiazine, or sulphathiazole in these conditions.

9. Streptococci are of outstanding importance in the respiratory diseases of the horse, and against this organism the heterocyclic sulphonamides are not very much more active than sulphanilamide. In addition, they do not produce much greater blood-levels in the horse. Sulphanilamide will doubtless therefore continue to

be used for these conditions, although the new drugs would be more effective. Sulphone produces methaemoglobinaemia in the horse, so cannot be used when there is respiratory distress, but produces better blood-levels than any of the sulphonamides in the horse. In the septicaemic diseases of the foal, which are often associated with Gram-negative organisms, the heterocyclic sulphonamides will obviously be superior to sulphanilamide.

10. The bacterial diseases of poultry are chiefly caused by Gram-negative organisms and it is probable that sulphamezathine, sulphamerazine and sulphadiazine will be the most effective drugs.

11. It appears that the injection of penicillin into the udder will be of special value in the treatment of mastitis. Apart from this important field, it will probably be less useful in veterinary than in human medicine.

12. In the farm animals, an initial dose of 0·1 to 0·2 gm./kg.* of sulphamezathine or sulphamerazine followed by a daily dose of 0·05 to 0·1 gm./kg. is adequate. In the calf these doses certainly need not be given more than once daily and probably not in the pig when sulphamezathine is used. Sulphamezathine is the most persistent of all the sulphonamides in the pig and the sodium salt can conveniently be given subcutaneously or intraperitoneally and need only be given once daily. To produce equal blood-levels the other sulphonamides would have to be given in larger and more frequent doses. In the horse and the sheep doses should be given twice daily and the total daily dose should not be less than 0·1 gm./kg. Both pigs and horses appear to eat sulphamezathine, sulphamerazine, sulphadiazine and sulphone more readily than the other sulphonamides.

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* A dose of 0·1 gm./kg. corresponds to a dose of 1 drachm per 60 lb. or 1 ounce per 6 cwt.

ATTESTED HERD BOOK PROPOSAL

In the march to the goal of attestation, observes the *Farming News*, "the Ayrshire breed has taken such a proud lead that it is not surprising that the latest step proposed is of the spectacular order," and continues: "Mr. George Ross, Fintry, who has allegiance to the Friesian fold as well as to Ayrshires, caused Ayrshire Cattle Society meeting to sit up and take notice when he proposed that their new objective should be a herd book restricted to attested entries. His idea is that, as the breed has such a large proportion of attested stock, they should give due notice, say three years, for reserving registration exclusively to attested animals.

"We agree with the proposer that no other single step would do so much to advertise the breed throughout the whole stock-breeding world. There are certain difficulties to overcome, of course, and the meeting took the right course in sending the proposal for examination by council."

* * * * *

It is clear that the future of agriculture in this country is likely to be bound up closely with milk production. We need much more milk, and the demand is likely to be permanent. Imported feeding-stuffs are likely to be difficult and expensive to obtain. But we need not be depressed or deterred. We have very great advantages in milk production which practically no other country can better: our climate is suitable, and we can certainly produce grass in abundance and over a long season of the year. More grass, better grassland management, more and better hay and a new approach altogether to the subject of silage and dried grass: these seem to be the likely basis of our policy for feeding-stuffs. But they are only the basis—a basis for action, by producers, by the new Advisory Service, by all who can advise and help and co-operate with farmers.—*Home Farmer.*

CLINICAL COMMUNICATION

Unusual Foreign Body—Dog

CHRISTINE A. WOODS, M.R.C.V.S.
AND
MARY DALBY, B.V.SC., M.R.C.V.S.
MENSTON-IN-WHARFEDALE

Subject.—Sealyham terrier dog, twelve months old.

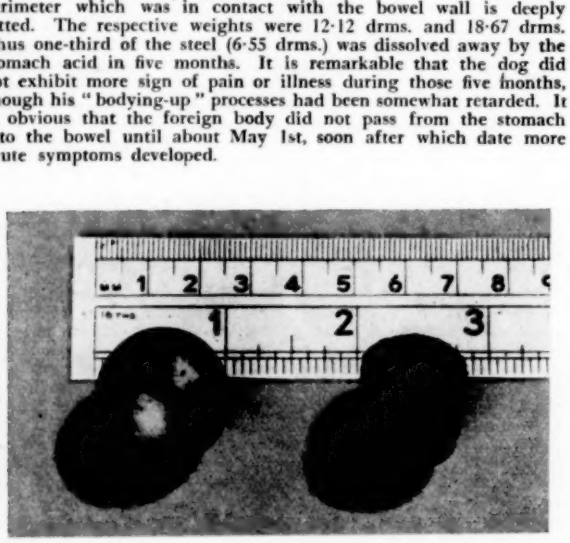
History.—The dog was brought to the surgery on the morning of May 5th, having shown dullness, anorexia and periodic vomiting for three to four days, with no passage of faeces, in spite of repeated attempts. Liquid paraffin had been given the day before he was brought to the surgery. For some months there had been occasional vomiting and the dog had a habit of lying on his back, but otherwise led a normal life. The owner tentatively suggested that a large steel ball-bearing might have been swallowed five months previously, but though this object had not been seen since, nobody but a child had witnessed the accident, and, in view of the dog's continued good health and brightness, it was concluded the ball-bearing must have been lost elsewhere. There was no history of bones having been fed.

Symptoms.—When first seen the dog was very dull, in obvious pain, and vomiting and straining intermittently. General bodily condition was poor. No foreign body was palpable owing to tensing of the abdominal walls. The rectum was entirely empty and clean.

Treatment.—The dog was taken into the kennels for observation and treatment. Rectal injections of warm, soapy water were returned unaltered except for a few shreds of mucous membrane. The liquid paraffin had not come through.

Early in the evening, with the owner's consent, the dog was anaesthetized, when a hard object could be felt well forward in the abdomen. Laparatomy was performed, and a strong metallic smell was noticed as soon as the abdomen was opened. The foreign body was located in the small intestine about eight inches from the pylorus, the intervening duodenum being acutely inflamed and distended by thick black fluid with a very strong metallic smell. The stomach appeared normal from the outside. The bowel behind the obstruction was empty and healthy-looking. Enterotomy was carried out and the ball-bearing removed. An umbilical hernia, present since birth, was reduced at the same time. Recovery was uneventful, healing was by first intention, and the sutures were removed on the fifth day. Rapid improvement in the general bodily condition was apparent immediately after the operation.

Remarks.—The accompanying photograph shows the swallowed ball and one which was similar to it before it was swallowed, against an inch rule. The former can be seen to be considerably flattened at the two poles in the lumen of the bowel, while the perimeter which was in contact with the bowel wall is deeply pitted. The respective weights were 12·12 drms. and 18·67 drms. Thus one-third of the steel (6·55 drms.) was dissolved away by the stomach acid in five months. It is remarkable that the dog did not exhibit more sign of pain or illness during those five months, though his "bodying-up" processes had been somewhat retarded. It is obvious that the foreign body did not pass from the stomach into the bowel until about May 1st, soon after which date more acute symptoms developed.



NEW INSTRUMENTS AND APPLIANCES

Cintel Metal Detector

L. GUY ANDERSON B.V.SC., M.R.C.V.S.,
AYLESBURY, BUCKS

During the last two or three years mine detectors and their various adaptations have been used by veterinary surgeons to assist in the diagnosis of traumatic reticulitis of cattle. The metal detector is made by Cinema-Television, Ltd., Worsley Bridge Road Sydenham, S.E.26, and is a compact outfit constructed primarily for the location of water pipes and other concealed metal objects but is well adapted for veterinary uses. The whole outfit fits into a box which can easily be carried and consists of a search head amplifier and head-phones

The search head is light and water-proof and easy to manipulate, having a detachable handle about 12 inches long. The ear 'phones are of the usual type and the amplifier is compact and small and slings round the operator's neck. It has only two controls—switch and selector—which are easy to adjust.

The writer has found it an advantage to have an assistant to move the search head while the operator carries the amplifier and head-phones, but this is not essential. The instrument appears to be more sensitive than the standard Army pattern mine detector and far more portable. The total cost is £48.

Whilst the instrument can be used to help to establish diagnosis it must be remembered that its use is limited in that foreign bodies are present in a large number of cattle without causing disease, and its use must not be allowed to replace careful clinical observation.

Care must be taken in use to see that no metal objects are near, even buckles of blankets, keys, money, etc., must be kept away from the search head. The writer has found it difficult to use indoors, and care must be taken, even in the open air, to see that no underground water pipes, etc., are near the site of operations.

Carefully used, however, this instrument is proving very usefu and, to date, all diagnoses, positive and negative, have been confirmed by operation, *post-mortem* examination or subsequent history.

Other possible veterinary uses for the instrument are the diagnosis of metallic foreign bodies in the feet or other parts of horses and cattle and, incidentally, the finding of instruments dropped in the bedding. On one occasion the writer found a metal hoof pick in the bedding which the owners were convinced had been swallowed by a hunter.

It is to be hoped that in the future more selective instruments will be produced, the performance of which will be unaffected by metallic objects which are any distance from the search head.

COLONIAL RESEARCH, 1945-46

Colonial Paper No. 208, published on February 3rd, 1947, sets out an impressive record of colonial research in 1945-46. It comprises the annual reports of the Colonial Research Committee, the Colonial Products Research Council, the Colonial Social Science Research Council, the Colonial Medical Research Council and the Committee for Colonial Agricultural, Animal Health and Forestry Research.

The first of these, the Colonial Research Committee, was set up in 1942 and the last three were established at the instance of this Committee in 1944 and 1945. The Colonial Products Research Council was set up independently in 1943. Side by side with the organizations thus created, there are attached to the Colonial Office a number of other expert bodies dealing with special topics. The Report of the Colonial Research Committee emphasizes that each of these main specialist bodies is directly advisory to the Secretary of State and is not a sub-committee of the Colonial Research Committee. The policy of the Colonial Research Committee in relation to them (as it is also in relation to research work initiated within the colonies themselves) is to delegate as many functions as possible within a framework mutually agreed, while themselves holding the balance between the claims of various subjects to encouraging the preparation of broad programmes of work. They themselves welcome proposals from all sources and do not wish to inhibit initiative on the part of other agencies or individuals. A table is included showing that a total of £1,000,000 has been allocated for research during the years 1940-46; the rapid rate of increase is indicated by the fact that of the 105 schemes approved no less than 54 were made during the year 1945-46.

ABSTRACTS

[The Effect of Penicillin on Cows Infected with *Brucella abortus*. Berman, D. T., Irwin, M. R., & Beach, B. A. (1946.) *Cornell Vet.* **36**. 311-313.]

Eight cows which had been used as controls in an experiment with strain 19 were exposed to a virulent culture of *Br. abortus* by the conjunctival route. All the animals aborted and a virulent strain of *Br. abortus* was isolated from the uterine discharge and colostrum of each of them. *Br. abortus* was subsequently found to be present in the milk of all the animals five months after infection. Four of the animals were given a total of 3,000,000 units of penicillin (beeswax-peanut oil suspension of the Ca salt) over a period of six days. The treatment had no effect on the presence or number of *Br. abortus* excreted in the milk, when compared with the four untreated control animals. The agglutinin titre of the blood serum was also unaffected.

[The authors mention some unpublished work on pentnucleotide (a substance stimulating production of white blood cells) in which they showed that this substance had no effect on the course of brucellosis in cattle.]

E. G. W.

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[Veterinary Inspection of Dairy Cattle in Connection with Diseases in Human Beings. Mullen, A. L. (1946.) *J. Roy. San. Inst.* **66**. 497-504.]

In a paper apparently written largely for members of the medical and sanitary professions interested in public health, the writer deals at some length with the regulations controlling the sale of milk from cattle affected with the diseases scheduled under the Food and Drugs Act.

Particular attention is paid to examination of herds where the milk has been shown, by a Medical Officer of Health's investigation, to be infected with tubercle bacilli. The statement that "the coming within the scope of the Tuberculosis Order is an obvious case recognizable to the average livestock owner" is one which reflects upon the interpretation of the Tuberculosis Order adopted and suggests that in the routine inspection of herds under the Food and Drugs Act only the most obvious cases of tuberculosis are dealt with.

Tuberculosis of the udder cannot be diagnosed definitely by clinical means alone, and the microscopic examination of milk films is not easy. When negative results are obtained a biological examination should be carried out.

In discussing Brucellosis, Mullen states: "The protection of the public from the sale and use of milk infected by *Br. abortus* and likely to cause undulant fever, does not appear to be covered by the main section 25; but in section 37, which refers to ice-cream, specific reference is made to any milk-borne disease which must necessarily include undulant fever. Powers to prevent liquid milk conveying undulant fever are apparently lacking, and this is an important factor in consideration of the problem and the procedure we adopt for its recognition and control."

Veterinary inspection of dairy cattle to detect the source of infection in undulant fever is difficult clinically, and even the absence of open cases in a herd does not eliminate the possibility of infection in apparently normal animals.

In discussion, Colonel J. A. Dixon condemns the delay involved by the Ministry's recommendation that in cases where a number of herds is involved in a tuberculous milk supply, the L.A. should re-sample the herds involved to narrow down the Ministry's subsequent investigation. With this, in reply, the essayist did not agree. The point at issue was that an immediate veterinary examination might well reveal one or more clinically affected cows whilst when referred back to the Ministry of Health for further sampling, the clinical cases would remain undetected until the results of the further biological test.

J. S. S.

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[The Effect of Vitamin A Deficiency on Reproduction in Dairy Bulls. Hodgson, R. E., Hall, S. R., Sweetman, W. J., Wiseman, H. G., & Converse, H. T. (1946.) *J. Dairy Sci.* **29**. 669-697.]

Previous work in the United States has shown that degenerative changes occur in the germinal epithelium of bulls fed diets deficient in vitamin A and that the condition can be cured by the administration of the vitamin, although the quality of the semen improves only slowly. In the present study, carried out during the years 1941-46, twelve bulls (six Holstein, five Jersey, one crossbred Red Danish *x* Jersey) were fed diets of varying vitamin A content until they developed the typical symptoms of blindness, incoordination, emaciation, and low plasma carotene and vitamin A. The semen from the bulls was shown to be fertile by artificial insemination of cows. Semen samples were usually obtained in an artificial vagina but in some cases had to be collected by massage since the animals refused to mount. The semen was low in concentration, had a high proportion of abnormal spermatozoa, and did not store well. When gross symptoms of vitamin A deficiency appeared before breeding age the bulls failed to breed; when symptoms appeared at the time of sexual maturity the animals frequently failed to breed shortly afterwards; when the deficiency developed after attainment of the breeding age the ability to breed was maintained.

At autopsy all the bulls showed cystic pituitary glands, up to four-fifths of the anterior lobe having been destroyed. The animals which developed symptoms of the deficiency earliest in life showed the most severe damage. Varying degrees of degeneration of the seminal epithelium were found.

The addition of small amounts of carotene (8 to 11 micrograms per lb. body weight) to the diet of four animals after symptoms of deficiency had occurred caused them to start breeding but failed to improve substantially the quality of the semen. Evidence of repair of the germinal epithelium of the testis was obtained at autopsy.

These experiments show that one important effect of a severe deficiency of vitamin A is inability of dairy bulls to mount and deliver semen. That this inability to breed was not due to blindness was shown by the observation that three blind animals continued to breed for a long time on the deficient ration. Damage to the anterior lobe of the pituitary may be responsible for failure of bulls to breed at the expected age but does not prevent bulls from breeding once this activity has started. Causes contributing to failure to breed probably include inanition, impaired growth, inco-ordination, and weakness. When carotene was fed to a deficient bull without providing additional food there was no improvement in breeding. It is clear that gross symptoms of vitamin A deficiency may appear before any serious impairment of reproductive performance occurs but such a severe deficiency is unlikely under practical feeding conditions. The minimum amount of vitamin A required to enable bulls to produce high quality semen over long periods remains to be determined.

E. G. W.

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[The Placental Transmission and Foetal Storage of Vitamin A and Carotene in the Bovine. Spielman, A. A., Thomas, J. W., Loosli, J. K., Norton, C. L., & Turk, K. L. (1946.) *J. Dairy Sci.* **29**. 707-715.]

A total of 33 pregnant heifers were allocated to four different diets approximately 60 days prior to calving. The diets were: (*a*) Low carotene diet; (*b*) Normal diet; (*c*) Normal diet with added carotene (1,000,000 i.u. daily); (*d*) Normal diet with added vitamin A (1,000,000 i.u. daily in shark-liver oil). Plasma carotene and vitamin A determinations were made on three successive days at the beginning of the experimental period (60 days before calving) and again about 18 days before calving. The vitamin A and carotene content of the plasma of the new-born calves was determined before they received colostrum. Several calves in each group were killed at birth and the amounts of carotene and vitamin A in the liver were determined.

No significant differences were observed in the mean plasma carotene of the new-born calves from the four dietary groups but the plasma vitamin A of the calves from cows given additional carotene was twice that of the normal group, and in the calves from cows given vitamin A the increase was fourfold. Carotenoids were present in the livers of all the calves in amounts proportional to the carotene content of the diet of the cow before calving. The cows which received 1,000,000 i.u. of vitamin A daily during the last 60 days of pregnancy gave birth to calves in which the average liver vitamin A at birth was almost 100,000 i.u.

It is of interest that the daily addition of 1,000,000 i.u. of vitamin A to the diet of the pregnant cows failed to cause a rise in their plasma carotene level; in some animals the level was in fact depressed below that in cows not receiving additional vitamin A. The plasma carotene of the new-born calf is apparently independent of the maternal plasma level.

Whether the feeding of additional vitamin A to the pregnant cow is of benefit to the new-born calf remains to be determined. These experiments show that such feeding produces an increased foetal storage of the vitamin in the liver but it would seem more economical to feed vitamin A directly to the new-born calf unless the possession of a large foetal store is found to be of particular value to the animal after birth.

E. G. W.

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Erratum.—Present Status of Gelatin Sponge, etc. (*Vet. Rec.* **59**. 125), for *J. Amer. vet. med. Ass.* read *J. Amer. med. Ass.*

REVIEW

[Veterinary Anaesthesia, by John G. Wright, M.V.Sc., F.R.C.V.S. (Second Edition). Pp. viii+218. 62 Figs. Baillière, Tindall & Cox, 7 & 8, Henrietta Street, London, W.C.2. Price 12s. 6d.]

We welcome the second edition of Wright's "Veterinary Anaesthesia" since we are confident that there will always be a steady demand for this book, which is the only British work on this subject, and since reasonably frequent revision of such a work is essential in the rapidly expanding sphere of anaesthetics.

The first edition received detailed notice in our columns, and the greater part of the text remains the same, additions or revisions having been made according to the author's experience in the interim and the published reports of new anaesthetic methods.

Some of the illustrations have been improved by being reproduced as half-tone drawings in place of line drawings; this gives greater realism in most instances.

The scope of the book has been extended to include a chapter on methods of anaesthesia employed for small laboratory animals, a feature which considerably enhances the value of the work for the majority of research workers.

The chapter on paravertebral anaesthesia in the bovine has been amplified in the light of recent experience and now includes a most useful illustration showing the areas supplied by the various nerves usually involved in paravertebral block.

The section dealing with narcosis in the equine has been rewritten in the light of the author's extensive experience of the use of intravenous chloral hydrate both for narcosis and anaesthesia in the horse. The author concludes that chloral hydrate is the best and safest narcotic for the horse, but that normally only a stage of deep narcosis is attained since if the drug is pushed to give full anaesthesia a prolonged and inconvenient period of recumbency is almost invariable. It is considered that chloral hydrate gives fairly satisfactory results in light anaesthesia of the bovine.

The chapter on inhalation anaesthesia in the dog and cat has been expanded to include sections on the use of ether by intratracheal intubation and on cyclopropane. Diagrams of suitable apparatus for both methods are included. Intra-tracheal ether gives better muscular relaxation and is safer over long periods than the methods now in use, but for average purposes in practice these advantages would appear to be outweighed by the necessity to induce lighter anaesthesia by barbiturates or ordinary inhalation ether before intubation can be accomplished.

In the case of cyclopropane the apparatus required, while not unduly complex, is perhaps rather more elaborate than that usually carried in everyday practice. This drug has the advantages that it is of low toxicity, that induction is rapid and the period of recovery short, the latter occasionally being accompanied by post-anaesthetic vomiting.

These remarks should serve to demonstrate the comprehensive and practical nature of the work and we are confident that those who were unable to obtain a copy of the first edition will lose no time in acquiring a copy of this new edition; it is a book no up-to-date practitioner or student can do without.

The general standard of the production is on the same lines as the first edition although there is a slight inevitable deterioration in the quality of the paper, and no art paper has been available for the illustrations. None the less this volume remains a credit to the publishers when one considers the difficulties encountered since the production of the first edition.

Weekly Wisdom

Ultimately all research is either a highly individual matter or one for small and closely knit teams of workers. . . . But all research in university institutions should be entirely free from bureaucratic control in any shape or form.—"The Outlook for Physiology," C. Lovatt Evans, *The Lancet*, January 18th, 1947. *1*. No. 3. Pp. 89-93.

* * * * *

For our own part we are convinced that greater knowledge of dietetics and metabolism will furnish the clue to more than one disease the origin of which is at the moment a mystery. The similarity, for example, between the pathology of swayback in sheep, due to a lack of copper in the pasture, and our own disseminated sclerosis is too striking to be purely fortuitous, while the part played by dairy produce in the genesis of gall-bladder and arterial disease may yet prove of unexpected but decisive importance.—*Medical Press.*

Victoria Veterinary Benevolent Fund

Meeting of Council

A meeting of the Council of the Victoria Veterinary Benevolent Fund was held at 10, Red Lion Square, London, W.C.1, on Wednesday, February 12th, 1947, when the following members were present: Mr. Arnold Spicer (President) in the chair, Mr. Esmond Brown, Professor J. B. Buxton, Mrs. D. I. Glover (representing the Ladies' Guild), Major L. P. Pugh, Lieut.-Col. G. B. Rees-Mogg, Lieut.-Col. P. J. Simpson and Professor G. H. Wooldridge. Apologies for absence were received from Mrs. G. N. Gould, Mr. John Holroyd and Capt. T. M. Mitchell.

Minutes.—The minutes of the previous meeting, held on July 31st, 1946, having been published, were taken as read and signed as correct.

Correspondence.—(*a*) The Hon. Secretary reported the receipt of a letter from Mrs. J. W. Rider intimating her resignation as Secretary from the Northern Counties Ladies' Committee and the appointment of Mrs. G. F. Pickering as her successor.

It was unanimously resolved, "That a special vote of thanks for the valuable work and help which Mrs. J. W. Rider had given to the Fund for many years, be recorded on the minutes."

(*b*) Arising out of the Bexhill Horse Show special subscription, the Hon. Secretary reported that the first allocation of this amount was made to the recipients of the Fund with their August monthly grant, and produced many letters of thanks and appreciation, several of which were read to the Council.

Accountant's Report

The accountant presented the following Report, which was approved:—

Since the previous meeting of Council, the following new or increased subscriptions (excluding those sent in as a result of the President's appeal for covenant subscriptions) and donations have been received up to the end of the financial year:—

Subscriptions

	£	s.	d.
National Greyhound Racing Club	5	0	0
V.V.B.F. Ladies' Guild	460	0	0
	£465	0	0

Donations

Collecting Boxes

	£	s.	d.	£	s.	d.
Central Veterinary Society	3	7	6			
Major F. Chambers	1	5	0			
J. L. Cormack	3	3	0			
Dumfries and Galloway Division	5	17	9			
Eastern Counties Society	0	16	0			
Major H. Gillmor	1	1	0			
Miss M. J. Farman	4	15	0			
G. N. Gould	1	3	0			
Lancashire Veterinary Association	6	17	9			
Lincolnshire and District	5	0	6			
Charles Masson	1	5	0			
Mid-West Veterinary Association	10	0	0			
I. T. Morton	1	4	6			
North Wales Division	5	8	7			
North of England V.M.A.	3	19	4			
Capt. C. M. W. Park	0	11	8			
Royal Counties V.M.A.	8	14	0			
Scottish Branch (A.G. Mtg. collection)	3	14	10			
Scottish Branch V.M.A.	2	9	6			
Scottish Metropolitan Division	3	5	0			
Southern Counties V.M.A.	7	5	0			
South Eastern Veterinary Association	9	0	0			
Sussex Division	3	10	0			
Western Counties V.M.A.	7	2	6			
A. Whicher	3	14	6			
Major W. H. Wortley	0	12	0			
Yorkshire Veterinary Society	7	10	0			
				112	12	11
Anonymous	1	5	0			
Ditto	1	0	0			
				2	5	0
Ayrshire Division V.M.A.				3	10	0
Major G. N. Bushman				1	2	0
Canine Insurance Association, Ltd.				5	5	0
K. G. D. Evans				2	2	0
Eastern Counties (Shipley Bowls Tournament)				10	10	0
H. K. Henley (non-member)				5	0	0
Lancashire Veterinary Association				5	5	0
Lincolnshire and District V.M.A.				5	10	0
Royal Counties (Special Victory Appeal)				42	16	0
Ditto (Special donation)				50	0	0
Society of Veterinary Practitioners				50	0	0
A. Whicher				0	12	0
				£296	9	11

Subscriptions by Covenant

In response to the President's appeal made to the profession in August last, 42 Covenants have been completed as follow:—

12 for 10s. 6d. from existing subscribers.
1 for 10s. 6d. from new subscriber.

*10 for £1 1s. from existing subscribers.
17 for £1 1s. from new subscribers.
1 for £2 2s. from existing subscriber.
1 for £2 2s. from new subscriber.

* Included in this figure are three subscribers who have increased their subscription from 10s. 6d. to £1 1s.

Dr. Fred Bullock's Memorial.—The total amount received to December 31st, 1946, in memory of our late Secretary was £170 18s.

On the proposition of the President, seconded by Professor J. B. Buxton, it was unanimously resolved, "That the Council desires to place on record its grateful thanks to Dr. W. R. Wooldridge for his kindness in arranging the printing and distribution in August last, of the President's Appeal asking members to become subscribers, and to complete a seven years' covenant to enable the Fund to benefit by the Income Tax reclaimable on such subscriptions."

It was further unanimously resolved, "That the sincere thanks of the Council be conveyed to the respective donors, and especially to the Ladies' Guild for their very generous subscription."

Investments

The accountant reported:—

(a) *Hunting Fund.*—The Trustees of this Fund had reinvested the £400 Queensland 3 per cent. Stock, which was redeemed on January 1st, 1947, in the purchase of £405 16s. 2½ per cent. Consolidated Stock.

(b) *Donations Account.*—The Treasurer had invested the balance of £445 standing in the Donation Account on October 22nd, 1946, in the purchase of 2½ per cent. Consolidated Stock.

(c) 3½ *per cent. Local Loans.*—The Fund's holding in this security amounting to £7,689 10s. 4d. was redeemable on January 5th, 1947.

Upon the Treasurer asking for instructions regarding the reinvestment of this amount, it was agreed that 2½ per cent. Consols should be purchased, the matter being left in his hands as to when this should be effected.

Cases

258. Aged 83. Infirm and ability to practise almost nil. Two daughters and two sons, one an M.R.C.V.S. The Executive Committee reported that a grant of £4 6s. 8d. per month had been made in this case as from November, 1946. A letter from a member of Council who was prevented from attending the meeting was read, and it was resolved, (*a*) "That the action of the Executive Committee be approved"; (*b*) "That this case be brought to the notice of the N.V.B. & M.D.S. with a view to that Society taking it over."

259. Age between 70 and 80. Widow. Old Age Pension and Supplementary Allowance of £1 6s. per week.

It was resolved, "That the Executive Committee's action in giving a grant of £1 per week as from January, 1947, be approved."

260. Daughter of late member. Aged 20. Came to England to train as nurse, contracted pulmonary tuberculosis, now a patient in a sanatorium.

The Hon. Secretary reported he had visited this case and recommended a small monthly grant as pocket money would be appreciated.

It was unanimously resolved, "That a grant of £1 per month be made in this case."

242. Son of widow already receiving assistance. Applies for financial assistance. The Council agreed with the report of the Executive Committee that this was not a case which should receive assistance; and reaffirmed its previous decision.

23. Widow. The Hon. Secretary submitted a report he had received on this case from a local member. It was agreed that the grant be discontinued.

244. Widow. Aged 70. The grant in this case was terminated last December on the death of the recipient.

212. Widow. Aged 78. Old Age Pension and Supplementary allowance of £1 4s. per week. Reported by daughter-in-law as having had a stroke causing paralysis of right side. After a review of this case, it was decided to increase the grant to £1 per week.

Christmas Gifts

The Hon. Secretary reported that the sum of £226 had been received from the V.V.B.F. Ladies' Guild to be specially allocated as Christmas Gifts. The amount of £220 had been distributed to 38 recipients in sums of from £3 to £10.

Letters from the recipients expressing their heartfelt thanks and sincere appreciation were read. The action of the Executive Committee in this matter was approved, and it was resolved,

(*a*) "That the cordial thanks of the Council be accorded to the Ladies' Guild for this munificent gift."

(*b*) "That excerpts of the replies received from the recipients be published in *The Veterinary Record.*"

(*c*) "That the amount of £73 8s. received in response to the annual appeal in *The Veterinary Record* be added to the balance in hand, and carried forward to help with next year's gifts."

QUESTIONS IN PARLIAMENT

Dairy Herds (Inspection)

Mr. G. Williams asked the Minister of Agriculture what percentage of dairy herds were inspected during 1946 by the State Veterinary Service.

Mr. T. Williams: Over 90 per cent.

. . . . .

Hill Sheep Subsidy

Mr. Richards asked the Minister of Agriculture whether he will consider doubling the Hill Sheep Subsidy in view of the serious losses that the hill farmer has sustained this winter.

Mr. T. Williams: I appreciate that very serious losses of sheep have occurred in hill areas owing to the exceptionally bad weather, but in accordance with the usual practice the effect of these losses will be taken into account in arriving at the rate of subsidy for next year.

. . . . .

Land Fertility Research

Mr. York asked the Minister of Agriculture how the sum of £40,278 2s. 5d. paid to the Departments of Agriculture by the Land Fertility Research Fund was arrived at; and what proportion of the total estimated cost of the advisory and investigation work this sum represents.

Mr. T. Williams: The total sum quoted, apart from £28 2s. 5d., the cost of certain small experiments undertaken by my Department, represents the full amounts borne on the Votes of the Departments in 1945-46 in respect of grants to colleges and institutions for advisory and local investigation work on the use of lime as a means of promoting the fertility of the soil. As regards England and Wales the payment of £34,816 represented about 13 per cent. of a total expenditure of £286,690 on specialist agricultural advisory and local investigation work, and in the case of Scotland the payment of £5,374 represented about 20 per cent. of a total of £26,402.

H.M. STATIONERY OFFICE PUBLICATIONS

The undermentioned have been published recently. Copies can be purchased through any bookseller, or directly from H.M. Stationery Office.

	Price net s. d.	*Post free* s. d.
House of Lords Papers and Bills (Session 1946-47):		
39. Penicillin Bill (H. L.)	0 1	0 2
Education, Ministry of:		
Scales of Salaries for the Teaching Staff of Farm Institutes and for Teachers of Agricultural (including Horticultural) Subjects, England and Wales. Report of the Committee. (Chairman: Lord Soulbury). Nov. 5th, 1946. (27-271) ...	0 6	0 7

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STANDARD TEST FOR "ORDINARY" MILK (SCOTLAND)

In response to representations by a number of local authorities the Rt. Hon. Joseph Westwood, M.P., Secretary of State for Scotland, has agreed to the introduction of a standard test for "ordinary" milk to ensure that such supplies are clean and safe for human consumption.

Designated and heat treated milks are already subject to prescribed tests giving some assurance that these reach the public in sweet condition. Under the new arrangements milk which is neither designated nor heat treated will be tested by means of a relatively simple test known as the Methylene Blue (Hiscox) Test. These arrangements are outlined in a Circular issued to local authorities by the Department of Health for Scotland.

Authorities are asked to adopt the test as a provisional standard for "ordinary" milk and to regard milk which fails to pass it as calling for investigation into the conditions of production or handling. The object is not to impose new requirements on farmers or dairymen but, by speedy discovery and improvement of unsatisfactory supplies, to ensure that existing requirements are more fully observed.

NOTES AND NEWS

Diary of Events

The special attention of Members of Council and Committees, N.V.M.A., is drawn to the dates of the March meetings, altered as notified in our issue of March 8th, and which are as follows:—

March 24th. 2.0 p.m. General Purposes and Finance Committee.
March 25th. 10.0 a.m. Veterinary State Medicine Committee.
2.0 p.m. Organizing Committee.
3.45 p.m. Home Appointments Committee.
(*Running concurrently*: 2.30 p.m. Technical Development Committee.)
March 26th. 10.30 a.m. **Council Meeting.**

Committees will be held at Gordon Square and the Council at the Connaught Rooms.

R.C.V.S. Council Meetings

A meeting of the Council of the Royal College of Veterinary Surgeons for registration purposes, Thursday and Friday, March 27th and 28th, 1947.

Quarterly Meetings of Council of the R.C.V.S., Wednesday, Thursday and Friday, April 9th, 10th and 11th, 1947.

Mar. 25th and 26th.—Annual Conference of the Association of Veterinary Students, at Streatley House, Streatley, Berks.

Mar. 28th.—Meeting of the Sussex Division, N.V.M.A., at Brighton (Old Ship Hotel), 2.30 p.m.

Mar. 28th.—Meeting of the Lincolnshire and District Division, N.V.M.A., at Grantham (George Hotel), 2.15 p.m.

April 3rd.—Meeting of the North Wales Division, N.V.M.A., at Ruthin (Council Chambers), 2 p.m.

April 3rd.—General Meeting of the Central Veterinary Society at the Royal Veterinary College, Royal College Street, London, N.W.1, at 2 p.m.

April 12th.—Meeting of the Association of Veterinary Teachers and Research Workers at the Royal Veterinary College, N.W.1, 11 a.m.

Apr. 16th.—Meeting of the Scottish Branch, N.V.M.A., at Stirling (Golden Lion Hotel), 2.30 p.m.

April 18th.—Yorkshire Division, N.V.M.A., Dinner and Dance at Leeds (Guildford Hotel). 7.30 p.m.

May 23rd.—R.V.C. Students' Union Society Annual Ball, Grosvenor House, Park Lane, W., 8 p.m. to 1 a.m.

July 28th—Aug. 1st.—N.V.M.A. Annual Congress in Edinburgh.

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Army Veterinary and Remount Services

The Retiring Director and his Successor

In our last issue we intimated that Brigadier James Joseph Plunkett, C.B.E., has assumed duty as Director, Army Veterinary and Remount Services, War Office, in succession to Brigadier George Alexander Kelly, C.B., who relinquished his appointment, on the expiration of his tenure, with effect from March 1st.

On Brigadier Kelly's appointment in March, 1943, we outlined his distinguished career and welcomed him as Director in the assurance that his knowledge of the functions of the Service in modern war, coupled with his wide executive and administrative experience, constituted a real safeguard for its future well-being, whatever vicissitudes might befall. How well Brigadier Kelly has carried out his onerous task is indicated by the recognition of the value of the services performed by the R.A.V.C. when at strength during the war, and of the necessity for its retention as an effective organization on the general reversion of the Army to a peace-time basis.

To the maintenance of the interests of the Corps in the difficult circumstances just indicated, Brigadier Plunkett brings the requisite qualities of personality and energy, together with a wealth of experience both of past affairs and of current problems.

Commissioned to the R.A.V.C. in 1914, a month after his graduation from the "Dick" College, he at once proceeded on Active Service, when, in France, on the Rhine and later in India, he acquired much veterinary hospital and mobile section experience and gained steady promotion. He was twice Mentioned in Despatches and was awarded the O.B.E. Returning to the United Kingdom in 1924 he served in the Aldershot and Southern Commands. He was promoted Major in 1925. The following year he once more embarked for India, returning from a full tour of duty in 1931, and in the following year being posted to the Remount Depot, Melton Mowbray, as Veterinary Officer in Charge.

Major Plunkett proceeded to B.E.F., France, as S.V.O. in December, 1939, but was evacuated with Staff Details, B.E.F., in May, 1940. Returning to the B.E.F. on June 8th, 1940, he finally embarked for the United Kingdom on June 18th, being a survivor of the S.S. "Lancastria" war tragedy. He was Mentioned in Despatches December, 1940, and appointed Commandant at Melton Mowbray. For a short period before D-Day in 1944 he assumed the appointment of A.D.V. & R.S., 21st Army Group. He later proceeded to C.M.F. and was appointed Deputy Director, Veterinary and Remount Services, H.Q., A.A.I., with the Acting rank of Colonel. In March, 1946, he proceeded to Germany from Italy and assumed the appointment of D.V. & R.S., Control Commission for Germany, being promoted Acting Brigadier with Temporary rank from September of that year.

Brigadier Plunkett was awarded the C.B.E. in September, 1945.

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PERSONAL

Birth.—Brain.—On March 10th, 1947, at Cheriton Nursing Home, Swindon, to Merie, wife of Peter G. P. Brain, B.Sc., M.R.C.V.S., a daughter.

Marriage.—Thomsett—Lay.—On March 8th, 1947, at St. Thomas-of-Canterbury Church, Goring-on-Thames, Oxon, Lovell Robert Thomsett, only son of Mr. and Mrs. E. L. Thomsett, of Osterley, and Edith Mary Lay, only daughter of Mr. and Mrs. H. Lay, of Goring. Mr. F. C. Hammond, M.R.C.V.S., was best man.

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R.C.V.S. OBITUARY

Harwood, Charles E. L., 301, Liverpool Road, Islington, N.1. Graduated London, December 17th, 1890. Died March 11th, 1947.

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ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Foot-and-Mouth Disease:

Dorset.—Frankham Farm, Ryme Intrinsica, Sherborne, Dorset (Mar. 16th).

Essex.—Elms Farm, Blackmore, Essex (Mar. 10th); Hyde Hall Farm, Rettendon Common, Chelmsford, Essex (Mar. 15th).

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R.S.I. "HEALTH CONGRESS" AT TORQUAY

The arrangements for the forthcoming Health Congress of the Royal Sanitary Institute at Torquay, which will be held from June 2nd to 6th next, are nearing completion. The Rt. Hon. the Earl Fortescue, Lord Lieutenant of the County, is the President of the Congress. A record number of delegates have been appointed to attend, including many from overseas.

The President of the Section (D) devoted to Veterinary Hygiene is Major W. Brennan DeVine and the Recording Secretary Lieut.-Col. J. A. Dixon. The Section holds its first session on Thursday, June 5th, when the subject for discussion is "Some Conditions Affecting the Liver in Food Animals." At the same hour (10 a.m.) on the following day the Section will meet to discuss "The Importance of Cowshed Hygiene in the Transmission of Milk-borne Diseases."

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CHEMICAL SOCIETY CENTENARY

The programme of the centenary celebrations of the Chemical Society on July 15th to 17th has now been published. These celebrations which, but for the war, would have taken place in 1941, are marked by a number of important events emphasizing the position of the Society and of chemistry in Britain to-day.

The scientific events of the programme include the Faraday Lecture to be delivered by Sir Robert Robinson, President of the Royal Society, lectures of a historical nature and visits to places of scientific interest in the London area. An exhibition in the Science Museum, South Kensington, which will be open to the public until the end of September, will illustrate the achievements of British chemistry during the past 100 years and its importance to the everyday life of the community.—*Pharm. J.*

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Lymphoblastoma, the most common malignant tumour of farm animals, occurs in the heart, spinal cord, spleen, kidney, liver and lymph glands.—*J.A.V.M.A.*

VETERINARY EDUCATIONAL TRUST

At a meeting of the British Greyhound Breeders' and Owners' Association, held on March 11th, Dr. W. R. Wooldridge explained the objects that lay before the canine research station, shortly to be established, and the gathering pledged itself to support the station. Those present agreed to forward to the director of the station the symptom record of the many recent outbreaks of disease in greyhounds both among puppies and grown dogs.

A score of breeders and owners recounted their grave losses and Dr. Wooldridge stressed the necessity of closer investigation into the complexities of breeding, feeding and management. A programme of planned research was wanted and would be entered into at the station. He reminded his hearers that the Trust is an independent organization and receives no assistance from the Government.

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SCHEME FOR THE CONTROL OF DISEASES OF DAIRY CATTLE

STATEMENT SHOWING THE NUMBER OF UNDERTAKINGS NOTIFIED TO THE MINISTRY OF AGRICULTURE DURING THE MONTH ENDED FEBRUARY, 1947

County	Undertakings Notified		Total Undertakings		
	During Month	Previously	Number	Number of Cattle	
				Cows	Heifers
ENGLAND					
Bedford	1	9	10	269	135
Berks	2	48	50	1,891	1,188
Bucks	2	42	44	2,025	1,139
Cambridge	—	—	—	—	—
Cheshire	10	135	145	4,744	1,915
Cornwall	—	—	—	—	—
Cumberland	—	8	8	278	249
Derby	33	187	220	7,147	2,574
Devon	6	148	154	2,010	1,381
Dorset	—	15	15	502	184
Durham	5	164	169	3,512	1,464
Essex	1	106	107	3,755	2,493
Gloucester	1	30	31	788	791
Hampshire	5	195	200	6,212	4,502
Hereford	—	5	5	194	121
Hertford	3	30	33	1,052	723
Hunts	—	—	—	—	—
Isle of Ely	—	1	1	57	21
Isle of Wight	—	—	—	—	—
Kent	1	75	76	1,826	1,301
Lancs	3	84	87	2,704	1,034
Leics	3	64	67	1,663	1,380
Lincs (Holland)	—	—	—	—	—
Lincs (Kesteven)	—	15	15	116	172
Lincs (Lindsey)	—	23	23	528	484
Middlesex	—	3	3	59	96
Norfolk	—	56	56	1,186	744
Northants	1	24	25	529	736
Northumberland	2	35	37	1,195	753
Notts	6	106	112	2,507	1,210
Oxford	—	12	12	274	267
Rutland	—	1	1	24	11
Salop	6	67	73	1,853	1,230
Soke of Peterborough	—	—	—	—	—
Somerset	8	105	113	3,061	1,713
Staffs	3	98	101	2,152	2,281
Suffolk (East)	—	24	24	415	339
Suffolk (West)	—	31	31	675	550
Surrey	4	44	48	1,367	798
Sussex (East)	6	47	53	2,502	1,067
Sussex (West)	4	21	25	607	400
Warwick	2	62	64	1,488	1,352
Westmorland	—	1	1	11	10
Wilts	1	46	47	1,959	917
Worcester	1	83	84	1,663	832
Yorks (E.R.)	1	46	47	1,006	569
Yorks (N.R.)	2	53	55	2,393	592
Yorks (W.R.)	3	113	116	2,744	1,210
WALES					
Anglesey	2	4	6	91	84
Brecon	—	7	7	114	71
Caernarvon	9	15	24	435	208
Cardigan	1	29	30	570	341
Carmarthen	7	132	139	2,639	1,436
Denbigh	—	13	13	331	120
Flint	1	27	28	686	376
Glamorgan	—	40	40	634	314
Merioneth	—	6	6	93	31
Monmouth	—	6	6	120	41
Montgomery	—	1	1	6	—
Pembroke	—	11	11	276	355
Radnor	—	—	—	—	—
TOTALS	146	2,753	2,899	76,938	44,305

Notes.—(1) Operative periods of undertakings: 1 year, 837; 2 years, 169; 3 years, 1,593. (2) Undertakings renewed for further periods: 1 year, 18; 2 years, 2; 3 years, 8. (3) Undertakings not renewed at end of operative periods, 206. (4) The figures showing the number of undertakings notified during the month relate to entirely fresh undertakings and do not include undertakings renewed for further periods. Undertakings which have been cancelled or not renewed are not included in the figures for previous notifications.

County	Undertakings Notified		Total Undertakings		
	During Month	Previously	Number	Number of Cattle	
				Cows	Heifers
SCOTLAND					
Aberdeen	—	17	17	891	381
Angus	—	14	14	581	425
Argyll	—	1	1	22	41
Ayr	—	9	9	325	203
Banff	—	1	1	120	20
Berwick	—	1	1	22	7
Bute	—	—	—	—	—
Caithness	—	—	—	—	—
Clackmannan	—	2	2	82	56
Dumfries	—	12	12	616	559
Dunbarton	—	1	1	60	40
East Lothian	—	1	1	20	8
Fife	—	19	19	611	405
Inverness	—	2	2	106	46
Kincardine	—	1	1	20	13
Kinross	—	3	3	60	43
Kirkcudbright	—	6	6	781	631
Lanark	—	6	6	274	185
Midlothian	—	—	—	—	—
Moray	—	—	—	—	—
Nairn	—	—	—	—	—
Orkney	—	—	—	—	—
Peebles	—	—	—	—	—
Perth	—	7	7	262	183
Renfrew	—	4	4	151	101
Ross-shire	1	1	2	86	62
Roxburgh	—	—	—	—	—
Selkirk	—	—	—	—	—
Stirling	—	8	8	294	245
Sutherland	—	4	4	85	39
West Lothian	—	2	2	75	22
Wigtown	—	15	15	1,084	628
Zetland	—	—	—	—	—
TOTALS	1	137	138	6,628	4,343

Notes.—(1) Duration of undertakings: 1 year, 33; 2 years, 6; 3 years, 99. (2) Undertakings renewed for a further period (included in column 2 of statement): 1 year, 103; 2 years, 9; 3 years, 70. (3) Undertakings expired and not renewed (not included in column 2 of statement): 257. (4) The figures showing the number of undertakings notified during the month relate to entirely fresh undertakings.

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TRACE ELEMENTS IN RELATION TO THE HEALTH OF LIVESTOCK

Contributing to a discussion by the Association of Applied Biologists on the significance of the presence of trace elements in plants and animals,* Dr. H. H. GREEN, of the Veterinary Laboratory, Ministry of Agriculture, Weybridge, dealt with the subject of trace elements in relation to the health of livestock.

If an element is found to be locally concentrated in some particular tissue, as, for example, iodine in the thyroid gland, said Dr. Green, the tendency is to assume a function for it, although it may be long before precise knowledge of that function is gained; but when the quantity of the element is not only exceedingly small but also is distributed throughout the tissues with no known sites of predilection, the impulse is to treat its presence as fortuitous until some instance of apparent absence is met in the form of an obscure deficiency disease, such as the "pining" of lambs caused by lack of cobalt, or until the effects of unusual excess are shown in the form of a toxicosis such as the "teart" of cattle in Somerset caused by excess of molybdenum.

Many of the trace elements found in living tissues are apparently inert; for example, nickel, although always present in soil-grown vegetation, does not appear to be an essential animal micronutrient, and relatively large amounts are harmless to animals. Some are important to plant physiology but of little consequence in animal economy. Boron is a limiting factor in plant health but, if essential for animal life at all, the smallest amounts ever found in plants are sufficient in the sense that no boron-deficiency disease has ever been recorded in animals. Zinc is certainly required by both plants and animals, and in the case of the latter it is the metallic component of the enzyme "carbonic anhydrase" found in considerable concentration in the red blood corpuscles and other tissues; but the quantities in plant food exceed animal requirements, and no naturally occurring zinc-deficiency disease has been encountered.

With other trace elements the position is reversed, and their significance in animal physiology is much greater than in plant economy. Cobalt, if of any significance in plants at all, is required in such small amounts that a pasture may be growing luxuriantly and yet induce emaciation and death in grazing ruminants; while selenium can be tolerated by growing plants in amounts which are exceedingly harmful to animals consuming them.

* *Nature*, February 8th, 1947 (**159**. 206-7).

Trace elements of proved economic importance are: iodine, copper, cobalt, manganese, selenium, molybdenum and fluorine. Lead and arsenic are neither biologically essential nor absorbed through plant roots in quantities injurious to animals. As for arsenic, the danger of cumulative poisoning is much exaggerated. Substantial sub-toxic doses repeatedly administered to sheep are rapidly eliminated, and the amounts naturally present in oysters and flat fish, although well above the limit sanctioned by health authorities concerned with arsenic as a food contaminant, are consumed without detriment to human health.

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MINISTRY OF AGRICULTURE NEWS SERVICE

Poultry : Looking Ahead.—Within the next year or two it is to be hoped that the feeding-stuffs position in this country will have so improved as to allow for a considerable expansion in the number of poultry now maintained. If the building up of the country's poultry is to rest on a foundation of good stock, preparations must be made now, for the hatchings of this year will be the breeding flock of 1949. Careful selection for culling of breeding stock or pens, especially on the ordinary farm, is essential.

In farmyard flocks the "old rooster" often escapes culling. The blame for poor performance in egg laying and appearance is accounted to the hens whereas in many cases it lies with the rooster who fertilized the eggs from which the hens were hatched. It is frequently said that the bull is half the dairy herd, and it may be said that the rooster is half the flock. There are many male birds that at present are passing on to generations of pullets and cockerels the bad characteristics that they themselves inherited.

Male birds should be selected for the same points of breed type and conformation looked for in the hens, and they should be purchased from a reliable breeder and not just at random. A first-year cockerel that proves himself a good breeder (and this can only be ascertained by the egg performance and build of his daughters), not only provides a good guide to the selection of another cockerel, but he is worth keeping on for a second year to mate with second-year hens, instead of following the usual practice of mating these with an early hatched cockerel.

Advantage of the Long-lived Herd.—It has been computed that on the average it takes two lactations for a cow to pay for the cost of raising her to a producing two-year old. This means that if she is disposed of at about six years old, it is only for two years out of the six that she is providing a profit for her owner. The older the cow, therefore, other things being equal, the greater lifetime profit she is likely to provide. With the same number of cows and the same average production, a long-lived herd can return more net profit than a short-lived herd. A dairy farmer whose cows live on the average to be only six years old needs 50 per cent. more stalls in his cowshed than he would need to make the same amount of net profit per year as the dairy farmer with cows of the same production living to the average age of ten years.

. . . . .

A Communal Grass Drying Experiment.—Grass is the natural and best feeding-stuff for dairy cows, and many dairy farmers have shown that high milk production can be obtained without imported concentrates, and at a lower cost, by using grass for both winter and summer feeding.

Some farmers, fortunately placed, have been able to install a grass-drying plant or have made silage using all the latest mechanical labour-saving devices; some have done both. But the problem of the small farmer is not so easily solved. The Milk Marketing Board, in co-operation with Imperial Chemical Industries, have therefore decided, as an experiment, to set up a grass drying unit which will serve a large number of small farmers. They aim to increase the output of pastures and to conserve for use in the winter months all grass that is not required for grazing and hay. In this way it is hoped to ascertain how far grass drying can be successful in producing an economic and valuable feed for better winter milk production.

The district chosen is that around Thornbury in Gloucestershire, and it is hoped that the plant will begin working on May 1st of this year. Farmers will be asked to sell grass to the Board and they will in turn be given the option to purchase an equivalent quantity of dried grass. The Board will provide the equipment for cutting and handling the grass, so that there will be no call on the farmer's own labour.

The experiment is designed to show how far a grass drying service can be successfully organized on a communal basis and how far modern methods in grass drying can be brought within the reach of the small farmer.

"SAFE SHELL-FISH"

Since the beginning of the present century those concerned with the trade in molluscan shell-fish have been confronted with two major problems: how to maintain supplies, more particularly of the native oyster, and how to prevent pollution of the shell-fish beds. The Ministry of Agriculture and Fisheries has tackled these problems, and has now issued a concise illustrated leaflet entitled "Safe Shell-fish," which explains how this has been accomplished. An account of the origin and effects of sewage pollution of shell-fish beds is given, reference is made to the types of illness which may be attributed to the eating of shell-fish, and the method of detection and assessment of pollution is described in detail.

Copies may be obtained from the Ministry of Agriculture and Fisheries, "Castle Bank," Conway, N. Wales.

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Mr. James Turner, President of the National Farmers' Union, has been appointed a member of the Agricultural Research Council.

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The greatest sheep disaster in living memory, in which blizzards and fodder shortage have combined to reduce Britain's hill flocks by one-third, has meant, apart from the loss of valuable foundation stock, a great loss of meat to the country and possibly as much as 70 per cent. of the hill wool clip.—*Farmers' Weekly.*

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Mr. J. G. Crowther, D.Sc., has been appointed Secretary-General designate of the World Federation of Scientific Workers, which was founded last year at a conference convened by the British Association of Scientific Workers. The President of the Federation is Professor F. Joliot-Curie, the High Commissioner for atomic energy in France. The Federation is preparing a charter of the rights and duties of scientists to serve as a guide to scientists in all countries.

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Particulars of a series of fortnightly Wednesday lectures and practical demonstrations to be held in the Riding School, Hyde Park Barracks, London, S.W.7 (by kind permission of the Officer Commanding, Household Cavalry), can be obtained from the National Horse Association of Great Britain, 43, Russell Square, London, W.C.1.

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Dr. A. R. T. Mattick has been appointed Assistant Director of the National Institute for Research in Dairying, and Mr. A. S. Foot has been appointed head of the dairy husbandry department to succeed Mr. J. Mackintosh who retired last September. Dr. S. Bartlett is the head of a newly established feeding and metabolism department.

DISEASES OF ANIMALS ACTS, 1894 TO 1937, AND AGRICULTURE ACT, 1937 (PART IV).

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period	Anthrax	Foot-and-mouth	Parasitic Mange*	Sheep Scab	Swine Fever
Feb. 1st to 15th, 1947 ...	4	8	—	1	6
Corresponding period in—					
1946 ...	3	4	1	7	42
1945 ...	5	2	—	3	58
1944 ...	15	—	—	6	31
Jan. 1st to Feb. 15th, 1947	9	49	—	13	8
Corresponding period in—					
1946 ...	18	17	4	16	90
1945 ...	18	25	1	11	145
1944 ...	39	3	3	40	79

NOTE.—The figures for the current year are approximate only.
* Excluding outbreaks in Army Horses.